Ucluelet AQUARIUM

MARINE DEBRIS INITIATIVE

ANNUAL REPORT

2021

PREPARED BY

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ACKNOWLEDGEMENTS

The Ucluelet Aquarium Marine Debris Initiative is made possible by the generous contributions of our funders and partners. A big thank you to the Pacific Salmon Foundation and Encorp Pacific, commonly referred to as Return-it, for making this years research possible. Thanks also to our previous funders, including The Clayoquot Biosphere Trust, Mountain Equipment Co-op and The Sitka Foundation for their support with this project in past years.

Our sincere gratitude to our partners, including, Surfrider Pacific Rim, Parks Canada, Cedar Coast Field Station, Hello Nature and Raincoast Education Society for continuing to provide support in research, education and resource sharing on this topic.

This ongoing research project would not be possible without the help of our volunteer 'citizen scientists', that have been instrumental in helping to gather this long term data. Thank you for your coming out to help, rain or shine.

Thank you to the Hesquiaht First Nation, Tla-o-qui-aht First Nations, Toquaht Nation, Ahousaht First Nations, and Yuułuʔiłʔatḥ Nation who have stewarded the lands and oceans in the Clayoquot and Barkley sound for thousands of years. Their culture, customs, language, traditional oral knowledge, and spirituality are rooted in the land and waters of this region. We are grateful to conduct our research, monitoring and education on their hahuuli (traditional territories).

Our mission is to raise awareness about local marine biodiversity and promote respect for the ocean environment. We greet visitors from all over the world treating them to a very personal view of the fish and invertebrates from our local waters in Clayoquot and Barkley Sounds.

CONTENTS

PROJECT SUMMARY & GOALS

The Ucluelet Aquarium's Microplastic and Marine Debris initiative began in 2017 and engages citizen scientists with collecting data on microplastic pollution in sediment, along the local beaches in Ucluelet, Pacific Rim National Park, and Tofino. As one of the first projects in British Columbia to scientifically monitor microplastic pollution in coastal sediments, the goal of this program is to better understand the frequency, distribution and type of microplastics along the west coast of Vancouver Island and create meaningful engagement with the public on this large-scale issue posed by marine debris in our ecosystems.

Results from, and participation in the project will help to protect the marine environment we are deeply connected to, inspire lifestyle changes to reduce plastic consumption, and find solutions to the ongoing issue of plastic pollution.

BACKGROUND

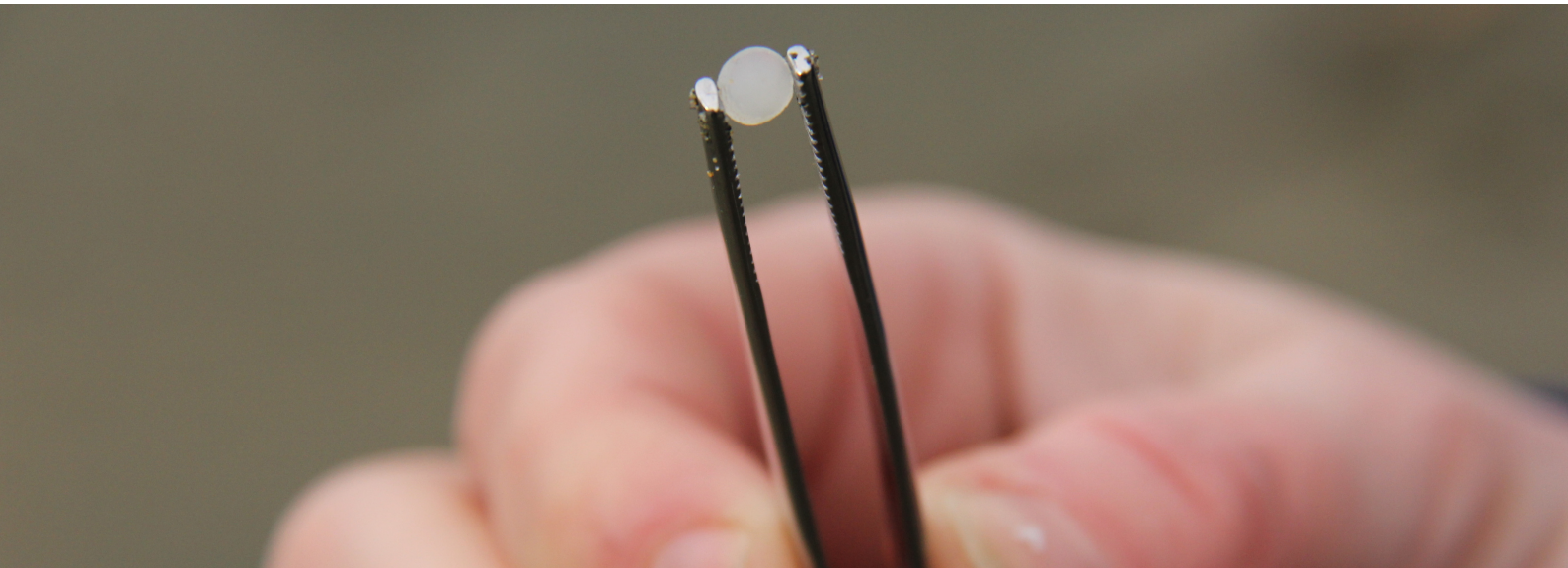
Microplastics and Marine Debris

Plastic is a widely used and versatile product, with over 300 million tonnes produced every year, half of which is used to make single use products (such as straws and plastic bags). At least 8 million tonnes of plastic end up in our oceans every year, this makes up 80% of all marine debris from surface waters to deep-sea sediments.

Most of this marine plastic originates from urban and storm runoff, inadequate waste management, industrial activities, construction and illegal dumping, as well as the fishing industry, nautical activities and aquaculture.

Plastic is formed by strong chemical bonds that bacteria cannot break down and therefore it never goes away (or biodegrades). Instead, natural processes such as, solar UV radiation wind and wave action break these plastic pieces into smaller fragments known as microplastics.

Microplastics and Marine Debris have serious impacts on the marine environment. Marine species can ingest or become entangled in plastic causing injury or death. Plastic has even become a vessel for invasive species altering the balance of some ecosystems. Plastic contains chemicals, as well as accumulates toxic contaminants leading to issues of bioaccumulation of toxins in food chains, with possible implications for human food safety and health.



Our small west coast communities rely on a healthy ocean in order to work, promote business, gather food, and take part in cultural activities. Microplastic pollution provides a multi-faceted danger to our health, economy, and culture. It alters the health of our local ecosystem and imperils the stability of our economy by polluting the food we eat, and by endangering the local marine wildlife that draws thousands of visitors every year.

The Ucluelet Aquarium is committed to spreading public awareness about marine debris and microplastic pollutants in the hopes of creating positive culture change and promoting community leadership through the Marine Debris Initiative.

SURVEY METHODS

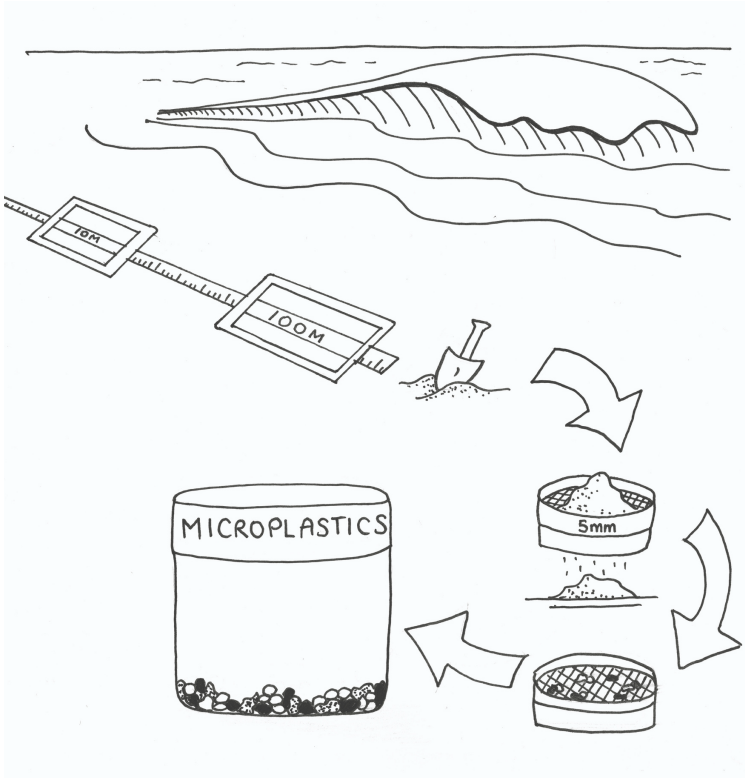
The Ucluelet Aquarium developed a citizen science microplastic study adapted from the National Oceanic Atmospheric Association (NOAA) sampling procedure. Starting in 2017, monthly surveys were conducted to determine the distribution, frequency and type of microplasic pollution found on local beaches in our region.

Sites were selected for sediment type, favouring sandy sediment with little to no gravel/pebbly sediment for sampling efficiency. From 2019 onwards the study site was limited to Wickaninnish Beach, allowing for more focused research in a consistent area.

Running a 100m transect along the most recent hightide line, ten quadrats were placed at randomly generated numbers along the line for sediment sampling. Using a trowel the top inch of sand was removed from each quadrat and placed in a seive (5mm sieve on top and 1mm seive on bottom). A bucket of water was used to flush the sand through the sieves and collect any microplastics present in the quadrat.

In this study microplastics, characterized as plastics between 1mm and 5mm, were divided into three main groups. 1) hard plastics, fragments from larger plastic materials. 2) nurdles, small plastic beads that are melted down and used as the primary materials for plastic production. 3) styrofoam, a commonly used form of plastic, used locally in our very own harbours to keep docks afloat.

The total monthly amounts and type of microplastics were recorded in ml over this five year period. Weather and ocean conditions, including swell period and hight, as well as tides were recorded for the study dates.



RESULTS

Our Findings: 2021 In Review

Twelve microplastic surveys were conducted monthly from January to December 2021, which collectively saw **over 300 ml of microplastics** from 100 square meters along the high tide line of Wickaninnish Beach.

Total monthly microplastic volumes were graphed between January and December shown in the figure below. Each month is further divided into the volume of each plastic type found (nurdles, Styrofoam, and hard plastics).

80ML

OF MICROPLASTICS FOUND IN FEBRUARY 2021

Our findings continue to show an increase in total volume of microplastics in the winter months, peaking at **80 ml in February**. This data is in line with previous years and supported by findings that show the impact of seasonal weather and ocean patterns on microplastic distribution. The winter storms in the Pacific Northwest bring strong winds and waves that accumulate marine debris, including microplastics, on our beaches.

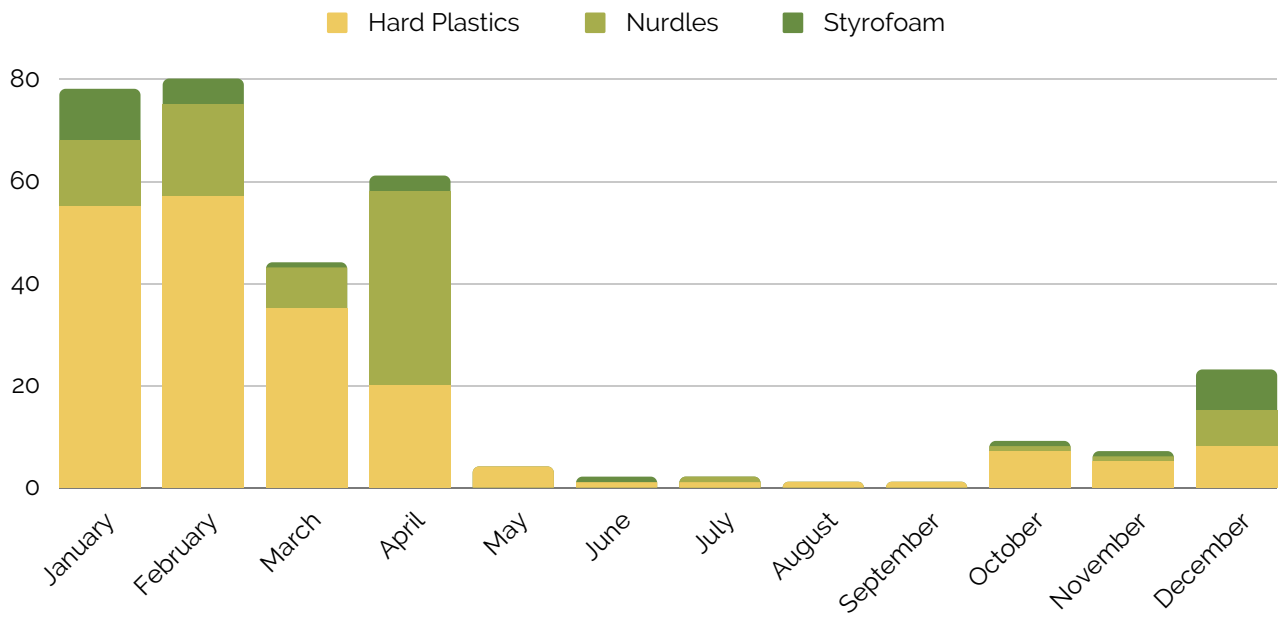


Figure 1. Total monthly microplastic volume (ml), as well as categorical volume of hard plastics, nurdles and styrofoam collected from Wickaninnish Beach from January to December 2021.

62.5% HARD PLASTICS

FOUND IN 2021

In 2021, we observed that hard plastic peices make up an average of 62.5% of microplastics, while nurdles make up 27.9%, and styrofoam makes up 9.6%.

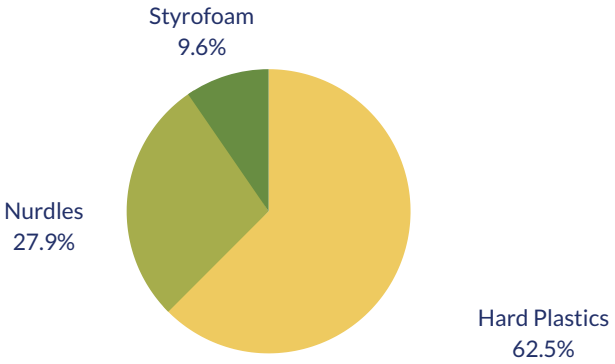


Figure 2. Total percentage of hard plastics, nurdles and styrofoam collected from Wickaninnish Beach in 2021

Figures 2-4 show that from 2019-2021 hard plastics made up more than 50 percent of the microplastics found in our study. Followed closely by nurdles, ranging from 27.9% in 2021 to 11.7% in 2020, and styrofoam ranging from 9.6% in 2021 to 28.6% in 2019. Styrofoam ranked lowest on type of plastc debris found, after nurdles, except in 2019, when 28.6% of the marine debris found comprised of styrofoam.

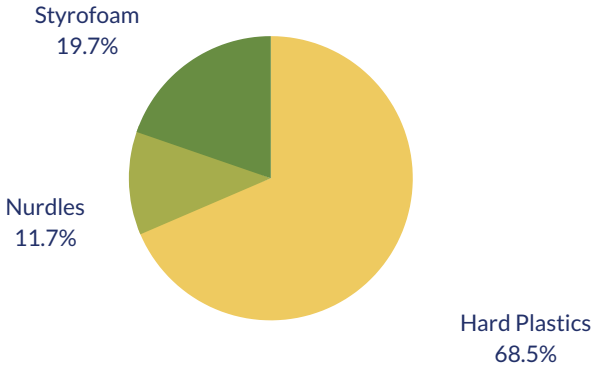


Figure 3. Total percentage of hard plastics, nurdles and styrofoam collected from Wickaninnish Beach in 2020.

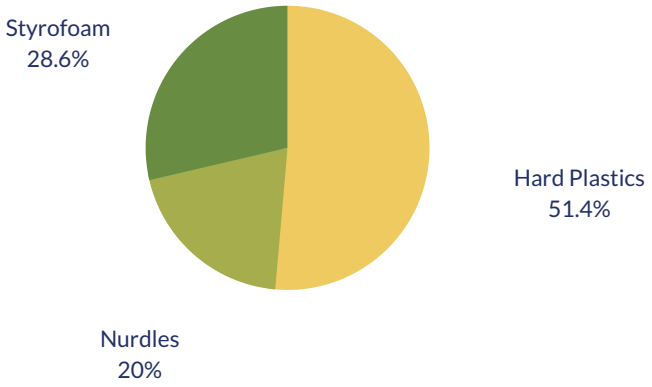


Figure 4. Total percentage of hard plastics, nurdles and styrofoam collected from Wickaninnish Beach in 2019.

FROM 2019-2021, MORE THAN 50% OF MICROPLASTICS FOUND WERE HARD PLASTICS

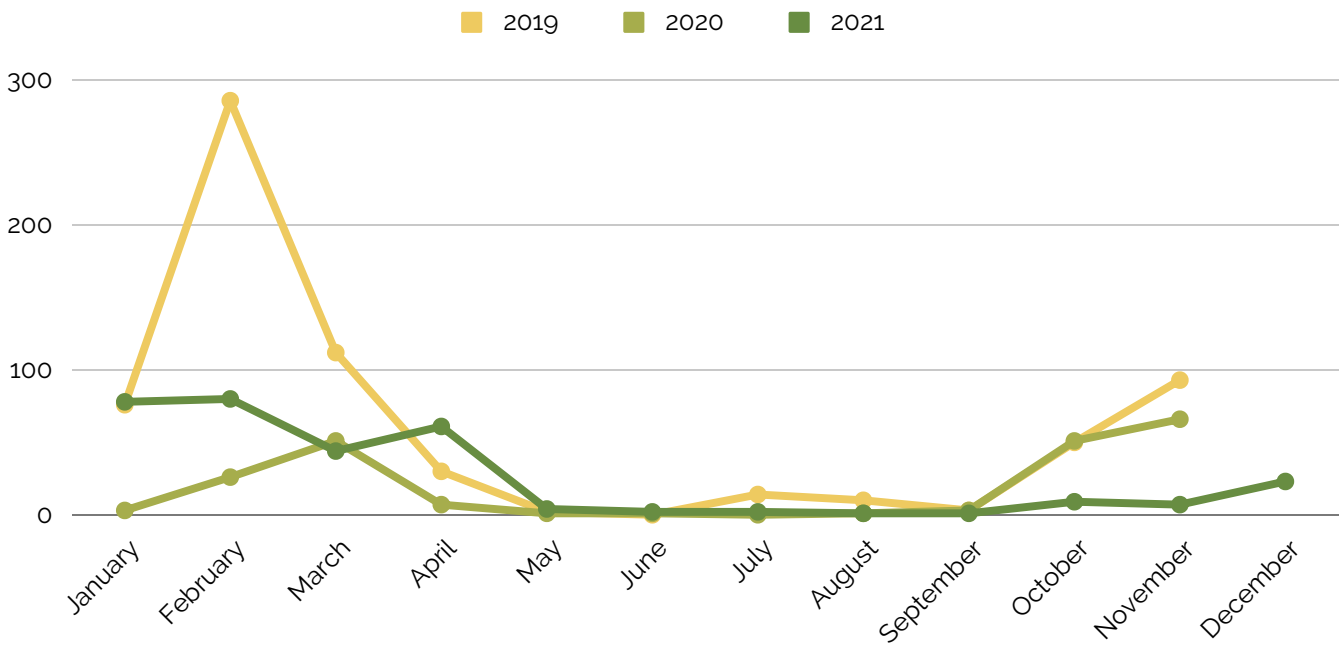


Figure 5. Total monthly microplastic volume (ml) collected from Wickaninnish Beach from January to December in 2019 (yellow), 2020 (light green), and 2021 (dark green).

We have compared the total microplastic volume (mL) of samples at Wickaninnish Beach between January and December 2019-2021 (Figure 5 above). This graph shows the difference in total volume of microplastics collected between years.

Our findings show that for 2019 there were some significant differences in the data compared to 2020 and 2021.
In 2019 we had higher than normal storm action, with a '50 year storm' on February 29th. This significant wind action and churning of the ocean explains the increase in microplastics found in February 2019 and the total microplastic amount found that year being greater compared to following years.

In 2020, a January storm left us with almost no plastic as the storm surge swept plastic up into the trees and a calm summer left us with many months of finding very little plastic on the beach. While we still saw more plastic in the winter months than summer months, as is consistent with our 2019 and 2021 data, we saw less plastic in total this year.

312ML MICROPLASTICS
FOUND IN 2021

210ML MICROPLASTICS
FOUND IN 2020

676ML MICROPLASTICS
FOUND IN 2019

CONCLUSION

The Take-Away

We have begun to see potential patterns from this study that could help us understand a few key things; what type of microplastic is most commonly present, if there is a seasonal effect on the amount of plastic washing up on shore, and the optimal season for beach clean ups to remove microplastic debris.

Our findings show that microplastics are predominantly present in the winter months (December-March) when the tides are higher and the ocean currents are stronger and the majority of the plastic debris found in this study is comprised of hard plastic pieces.

Some of the factors at play contributing to microplastics in the sample area are: frequency of storms, swell direction, timing of tides, and local currents along the beach. More frequent storms can mean more debris washed ashore, different swell directions or currents could leave plastic deposited elsewhere on the local shoreline, and the timing of tides can have us sampling a lower high tide line that may have different plastic debris.

OUR RESEARCH SHOWS A CORRELATION BETWEEN AMOUNT OF MICROPLASTICS COLLECTED FROM SHORELINES AND TURBIDITY OF OCEAN CONDITIONS

WITH HIGHER LEVELS OF MICROPLASTICS FOUND IN THE WINTER MONTHS

A SNAPSHOT

A recent study showed that more than five trillion pieces of plastic, collectively weighing nearly 269,000 tonnes, are floating in the world's oceans.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RESEARCH ARTICLE

Plastic Pollution in the World's Oceans: More than 5 Trillion Plastic Pieces Weighing over 250,000 Tons Afloat at Sea

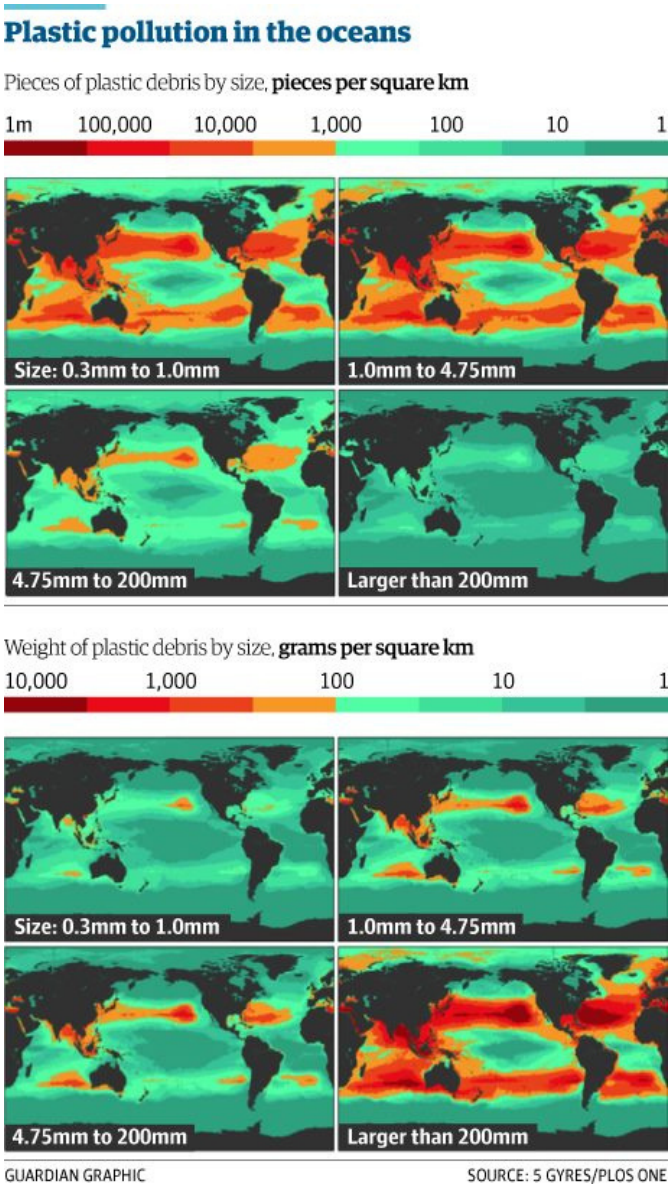
Marcus Eriksen, Laurent C. M. Lebreton, Henry S. Carson, Martin Thiel, Charles J. Moore, Jose C. Borerro, Francois Galgani, Peter G. Ryan, Julia Reisser

5,018 Save | 1,980 Citation | 584,572 View | 1,489 Share

The study found that most of the oceans plastic accumulates in the five large ocean gyres, circular currents churning up plastics in a set area.The gyres themselves are likely to contribute to microplastics, acting as 'shredders' to plastic before dispersing it.

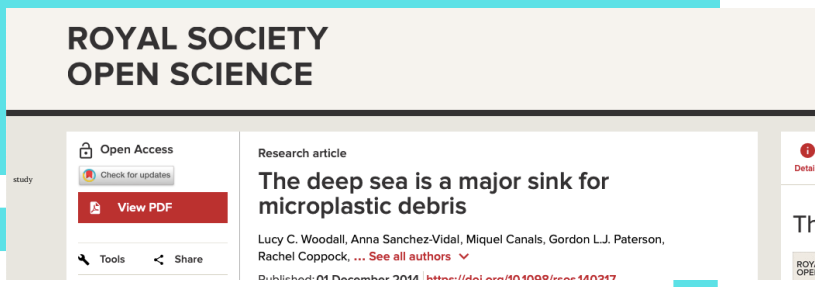
Using this research, the first oceanographic model of debris distribution was generated to estimate global distribution and count and weight densities of plastic pollution by size (shown on the right).

This model shows that the majority of plastic pieces in the ocean are between 1 and 4.75mm, known as microplastics. These plastics are also found in some of the highest densities in our ocean, the Pacific Ocean. Looking at the patterns of debris type and movement in this model may help explain some of our findings.



A SNAPSHOT

The deep sea is a major sink for microplastic debris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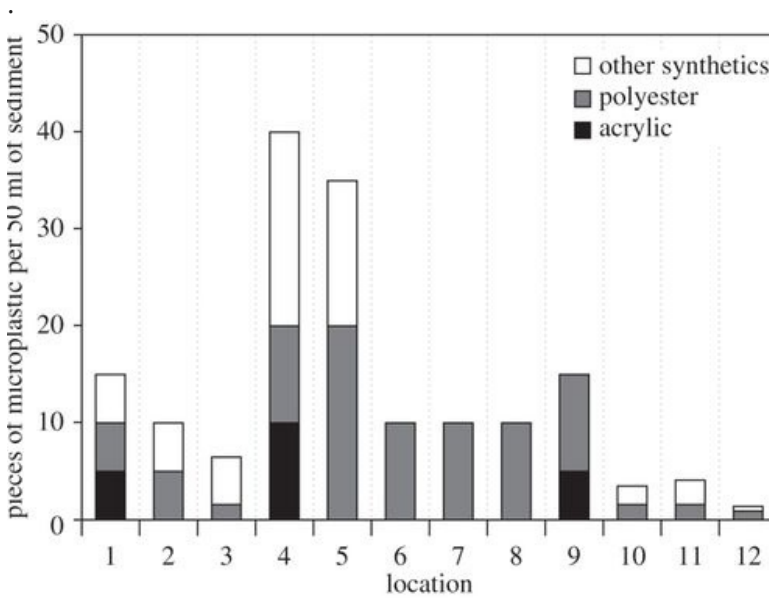
Research article
The deep sea is a major sink for microplastic debris
Lucy C. Woodall, Anna Sanchez-Vidal, Miquel Canals, Gordon L.J. Paterson, Rachel Coppock, ... See all authors

If there are 5tn pieces of plastic in the world's oceans, weighing nearly 269,000 tonnes, that is just 0.1% of annual global plastic production. So where is all the plastic?

Analyzing samples from 12 sites in the Atlantic Ocean, Mediterranean Sea and Indian Ocean taken between 2001 and 2012, scientists found that deep sea sediments are acting as a sink for microplastics.

The tiny fibres were found at depths from 300m down at the shallowest in the Mediterranean to over 3,000m deep, at volumes 1,000 times higher than those at the surface of the sea

The abundance of plastic at such depths has negative ramifications for marine life, though we still know so little about the deep sea, that the full scale of the effects of this level of plastic pollution needs further investigation. .



The study says more research is needed. "A range of organisms are known to ingest microplastics, and there is concern this could result in physical and/or toxicological harm," the authors warn.

EDUCATION & OUTREACH

Microplastic pollution is a global issue that needs to be understood on a local level in BC. Research like this, involving citizen science, allows us to learn more while engaging our local communities.

CITIZEN SCIENCE

Citizen science enables the public to make a direct contribution to research and gain insights about their environmental impacts. Citizen scientists also help researchers maximize the amount of data collected on a project!

With the help of citizen scientists, the Microplastic and Marine Debris Initiative has been successful in:

1) Increasing available information on microplastic pollution on the west coast of Vancouver Island.
2) Understanding the type and distribution of microplastic pollution in coastal sediment.
3) Learning about the ecological impacts of microplastics in local marine environments.
4) Sharing solutions and resources with the public about eliminating plastic consumption and waste

The Marine Debris Initiative has trained more than 238 citizen scientists directly through the microplastic sampling.

FROM 2017-2021 THE MARINE DEBRIS INITATIVE HAS TRAINED

MORE THAN 200 CITIZEN SCIENTISTS

WITH 30 NEW CITIZEN SCIENTISTS TRAINED IN 2021

WHO COLLECTIVELY SPENT 98 VOLUNTEER HOURS RESEARCHNG MICROPLASTICS IN 2021

Over the course of the project, between Januray 2017 and December 2021, 60 microplastic samples have been taken at 7 local beaches.

60 SAMPLES AT 7 LOCAL BEACHES

M151- NATIONAL STRATEGY TO COMBAT PLASTIC POLLUTION

The Initiative has generated numerous outreach events, some of which involved important leaders of change. In June, 2018 we supported MP Gord Johns campaign M-151, a national strategy to combat plastic pollution, a bill that was recently passed. In the summer of 2018, we had the opportunity to share our work on microplastics with the Minister of Environment and Climate Change Canada, Catherine McKenna.

PLASTIC FREE MARKET

In 2018 the Ucluelet Aquarium also hosted two Plastic Free Markets. This unique market gave locals and visitors the opportunity to find alternatives to plastic and support a movement towards plastic free habits.

The Ucluelet Aquarium has been fortunate to share its sampling procedure with community organizations, including Surfrider Pacific Rim and Cedar Coast Field Station. to allow further microplastic sampling at our local beaches.

NEXT STEPS

The highlight of this project was how it enabled connections to be made between individuals and the ecosystems that support them. Allowing people to see the plastic problem first hand created a ripple effect from within our community.

One of this project's successes has been to create conversations about solutions and resources to mitigate plastic consumption. We now need to look further into the impacts of microplastics on our local food sources and ecosystems, and work diligently to put an end to the systems that contribute to plastic pollution.

Further funding will allow the Aquarium to continue investigating how our local habitats and species are at risk, and how this further puts our human communities at risk. It will allow us to continue to use the data we are gathering in outreach programs with school groups, youth groups, and at public events and gatherings.

We will be working on ways to communicate the data we have gathered with the public and to find ways for individuals and communities to take steps that lead to solutions.

More studies are needed to look into how microplastics interrupt food webs and damages marine habitats, how individual species are affected as well as how big picture systems are being affected.

We are looking forward to further researching this issue and working with our partners and supporters as well as current and future citizen scientists.

THIS STUDY HIGHLIGHTS THE NEED FOR US TO

'TURN OFF THE TAP'

OF PLASTIC POLLUTION.

While this can feel overwhelming, there are many actions we can take:

- Stop using single-use products
- Repair, reuse, refuse, share, lend and borrow
- Support circular economies
- Support legislation that creates positive change
- Get involved, volunteer and write to your local representative

are all of the ways we can reduce the flow of plastic into the sea.

THANK YOU!

To our previous and current partners, sponsors, and donors!
If you would like to support this project please contact our marine debris coordinator:
marinedebris@uclueletaquarium.org

REFERENCES

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APPENDICES

APPENDIX A

A summary of monthly microplastic survey findings at Wickanninish Beach, from January- December 2019-2021. Including total monthly microplastic volume (in ml), as well as categorical volume of hard plastics, nurdles and styrofoam collected in each monthly sample during the study period.

		Type of plastic (volume in ml)			
Year	Month	Hard plastic	Nurdle	Styrofoam	Total
2019	January	44	12	20	76
2019	February	165	44	77	286
2019	March	63	14	35	112
2019	April	18	6	6	30
2019	May	0	1	1	2
2019	June	0	0	0	0
2019	July	6	1	7	14
2019	August	4	1	5	10
2019	September	1	1	1	3
2019	October	43	6	1	50
2019	November	52	29	12	93
2019	December	0	0	0	0
2020	January	1	1	1	3
2020	February	20	4	2	26
2020	March	35	11	5	51
2020	April	0	0	0	0
2020	May	5	1	1	7
2020	June	1	1	1	3
2020	July	1	0	0	1
2020	August	0	0	0	0
2020	September	1	0	1	2
2020	October	1	0	2	3
2020	November	45	4	2	51
2020	December	36	3	27	66
2021	January	55	13	10	78
2021	February	57	18	5	80
2021	March	35	8	1	44
2021	April	20	38	3	61
2021	May	4	0	0	4
2021	June	1	0	1	2
2021	July	1	1	0	2
2021	August	1	0	0	1
2021	September	1	0	0	1
2021	October	7	1	1	9

APPENDIX B

Template of microplastic sampling sheet for monthly microplastic surveys created by the Ucluelet Aquarium, adapted from NOAA marine debris accumulation study sheet.

Record

Shoreline Characteristics Sheet and Microplastics Sampling	Surveyor Name & Phone Number	
	Sampling Date	

Sampling Area:

Shoreline ID			
Beach/ Shoreline Name			Common name of beach/park or specified given name of section of shoreline
Coordinates at Start of Transect	Latitude	Longitude	Latitude and longitude to be recorded as XXX.XXXX (decimal degrees) at start and end of shoreline sampling section (transect)
Coordinates at End of Transect	Latitude	Longitude	
Time of Sampling	Start	End	Record in 24 hour time
Photo Number/ID			Digital ID number of first and last photo taken of site (if applic.)

Shoreline Characteristics:

Substratum Type		For example, sandy or gravelly
Substrate uniformity		Percent coverage of main substrate type (%)
Tidal Range		Max. And min. vertical tidal range on sampling date. Use tide chart (report in meters)
Tidal Distance		Horizontal distance (in meters) from low to high tide line. Measure at low/high tides or estimate based on wrack lines

Back of shoreline		Describe landward limit (vegetation, dunes, parking lots etc…)
Aspect		Direction you are facing when you look out at the water (ie. NW)

Land-use characteristics- within shoreline location:

Location & Major Usage (Urban, Suburban, Rural)			Select one and indicate major usage (ie. Recreation, boat access, remote etc…)
Access			Vehicular (can drive to site), pedestrian (must walk), isolated (need boat)
Nearest Town			Name
est Town Distance			Distance in kilometers
Nearest River			If applicable, name the river or stream
Nearest River Direction and Distance			Report the distance in km and cardinal direction from site
River/Stream/Creek input to beach	YES	NO	Circle appropriate (if nearest river or stream has outlet in shoreline sampling section)
Pipe or Drain Input to Sampling Site	YES	NO	Circle appropriate (if storm drain or other outlet in shoreline sampling section)
Further Notes (including description, landmarks, fishing activity, drawings etc.)			

*sampling sheet adapted from NOAA marine debris accumulation study sheet